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**BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES**

Application Number: 10/540,881
Filing Date: January 18, 2006
Appellant(s): TAKATSU ET AL.

Jay E. Rowe, Jr., Ph.D.
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed 05/12/2011 appealing from the Office action mailed 09/01/2010.

(1) Real Party in Interest

The examiner has no comment on the statement, or lack of statement, identifying by name the real party in interest in the brief.

(2) Related Appeals and Interferences

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) Status of Claims

The following is a list of claims that are rejected and pending in the application:

Claims 1-4 and 7-16.

(4) Status of Amendments After Final

The examiner has no comment on the appellant's statement of the status of amendments after final rejection contained in the brief.

(5) Summary of Claimed Subject Matter

The examiner has no comment on the summary of claimed subject matter contained in the brief.

(6) Grounds of Rejection to be Reviewed on Appeal

The examiner has no comment on the appellant's statement of the grounds of rejection to be reviewed on appeal. Every ground of rejection set forth in the Office action from which the appeal is taken (as modified by any advisory actions) is being maintained by the examiner except for the grounds of rejection (if any) listed under the

subheading "WITHDRAWN REJECTIONS." New grounds of rejection (if any) are provided under the subheading "NEW GROUNDS OF REJECTION."

(7) Claims Appendix

The examiner has no comment on the copy of the appealed claims contained in the Appendix to the appellant's brief.

(8) Evidence Relied Upon

Japanese Patent Abstract Publication No: 2001-278602, (machine translation)

Takashi et al. 10/10/2001

US 2001/0014304 A1 Satokawa et al 08/16/2001

(9) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

Claims 1-4 and 7-16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Takashi et al (Japanese Patent Abstracts Publication No: 2001-278602) ("Takashi") in view of Satokawa et al (US 2001/0014304 A1) ("Satokawa").

With respect to claims 1, 4 and 16, Takashi discloses removal of sulfur compounds from a petroleum system hydrocarbon feed by first contacting the feed with a first adsorbent (it is to be noted that Takashi uses the term "devulcanizing agent" for desulfurization agent) to remove benzothiophenes or dibenzothiophenes and then with a second adsorbent to remove mercaptans, thiophenes, dibenzothiophenes, sulfides, and disulfides (See paragraph 0004 and 0005).

Takashi discloses a desulfurizing agent A comprising a Group 17 element supported on a zeolite (See paragraph 0008).

Takashi also discloses that for the second adsorbent (desulfurizing agent B), there is especially no limit, it may use another desulfurizing agent and may use hydrodesulfurization catalysts such as Co-Mo/Alumina and Ni-Mo/Alumina (See paragraph 0010). It is to be noted that Co-Mo/Alumina and Ni-Mo/Alumina are metal component-carried on a porous inorganic oxide.

Takashi discloses LPG, gasoline, naphtha, kerosene, and gas oil as the preferred petroleum system hydrocarbons (See paragraph 0008).

Takashi invention does not appear to specifically disclose the claimed metals carried on zeolite beta and/or faujasite as agent A.

Satokawa invention discloses a process for desulfurization of hydrocarbon feed (See paragraph 0004, 0027; claim 10) similar to Takashi under similar operating conditions (See paragraph 0026) using Y- and beta-zeolites (See paragraph 0023). Satokawa also discloses that by using one or more transition metals selected from silver, copper, zinc, iron, cobalt, and nickel supported on zeolite, improves the adsorption characteristics of sulfur compounds irrespective of the moisture in the fuel gas (See paragraph 0030, 0032). This indicates that a Group 17 element supported on a zeolite, used in Takashi invention, and transition metals supported on a zeolite, used in Satokawa invention, are functionally similar in the desulfurization process.

Therefore, it would have been obvious to one with ordinary skill in the art at the time of invention to modify Takashi invention and use the transition metal supported zeolite as the desulfurizing agent A, as disclosed by Satokawa, for an improved desulfurization.

With respect to claim 2, Takashi does not appear to specifically disclose that the desulfurizing agent A has higher desulfurizing performance to sulfides and disulfides than desulfurizing agent B and desulfurizing agent B has a higher desulfurizing performance to carbonyl sulfide than that of desulfurizing agent A. However, since combined invention of Takashi and Satokawa uses a feed and desulfurizing agents A and B similar to the Applicant's claim, the combined invention should necessarily be achieving similar performance of desulfurizing agents A and B as claimed.

With respect to claim 3, Takashi invention does not appear to specifically disclose the volume ratio of desulfurizing agents A and B, however, it would have been obvious to one with ordinary skill in the art at the time of invention to specify the volume ratio of desulfurizing agents A and B in the modified Takashi invention which is expected to be in a range as claimed, because Takashi in view of Satokawa uses agents similar to the Applicant's claim.

With respect to claim 7, Takashi invention discloses temperature of the desulfurizing bed to be from -40 to 100°C (See paragraph 0009).

With respect to claims 8 and 9, Takashi invention discloses LPG and naphtha fraction as hydrocarbon containing gas for fuel cell (See paragraph 0008).

Takashi invention does not specifically disclose LPG and naphtha containing less than 0.1 weight ppm carbonyl sulfide. However, the invention does disclose that total sulfur content must be below 0.2 weight ppm (See paragraph 0002, 0011). Since Takashi's disclosure of total sulfur content includes mercaptans, thiophenes, benzothiophenes, dibenzothiophenes, sulfides, and disulfides (See paragraph 0005), it should necessarily include carbonyl sulfide also. When the concentration of all sulfur compounds is below 0.2 weight ppm, clearly, the concentration of carbonyl sulfide must be below 0.1 weight ppm.

With respect to claim 10, modified Takashi invention discloses desulfurization of LPG and naphtha fraction by using a desulfurizing agent comprising a zeolite (See Takashi, paragraph 0008; Satokawa, paragraph 0023).

With respect to claims 11 and 14, Takashi invention discloses a process for producing hydrogen for a fuel cell by contacting the petroleum system hydrocarbon (LPG, gasoline, naphtha, kerosene) after conducting the desulfurization process of the invention, with a steam reforming catalyst (See paragraph 0012).

With respect to claims 12 and 15, Takashi invention discloses using ruthenium base or nickel base catalyst for steam reforming (See paragraph 0012).

(10) Response to Argument

The Appellant takes the position (arguments, page 4-6) that:

- 1) Takashi is directed to a method for removing sulfur contaminants from petroleum hydrocarbon oils (abstract).
- 2) Takashi teaches the HBr system is superior to metal exchanged zeolite system for removal of benzothiophenes and dibenzothiophenes from petroleum hydrocarbon oils.
- 3) On page 5, the Appellants submit that the secondary reference to Satokawa is directed to the removal of sulfur compounds from a gaseous mixture which is different from the removal of benzothiophene and dibenzothiophene from petroleum hydrocarbons by Takashi and that Takashi teaches away from metal exchanged zeolites as being effective for removal of benzothiophene and dibenzothiophene from a petroleum hydrocarbon.
- 4) Appellants submit that as described above, the Office's statement is erroneous. The two methods are not functionally similar and one of ordinary skill in the art would not look to the description of Satokawa to address removal of benzothiophene and dibenzothiophene from a petroleum hydrocarbon. Takashi indicates that such treatment is not effective and for that reason employs the HBr method.

5) Applicants submit that the data shown in the Table demonstrates a synergistic improvement in desulfurization is obtained by the combination of agents A and B according to the invention.

Regarding item 1) Examiner notes that Claim 1 requires "a hydrocarbon-containing gas" including LPG (claim 9). Takashi discloses using "a petroleum system hydrocarbon" including LPG (See paragraph 0008). Satokawa discloses using fuel gases including LPG (See paragraph 0004, 0027; claim 10).

Regarding Items 2 and 3) above, it is the examiner's position that thiophenes disclosed by Satokawa is generic to benzothiophenes and dibenzothiophenes disclosed by Takashi. Takashi also discloses, "Then in order to have removed effectively the benzothiophene which is hard to be desulfurized among the sulfur compound in a petroleum system hydrocarbon, i.e., a mercaptan, a thiophene, a sulfide, disulfide, benzothiophene, and dibenzo thiophenes, and dibenzo thiophenes...."(Paragraph 0005). This indicates that benzothiophene and dibenzo thiophenes are more difficult to remove as compared to other sulfur-containing compounds and therefore, Takashi uses HBr on zeolite (Agent A) to address this specific problem (See paragraph 0005, 0007). Takashi further discloses that this agent (HBr on zeolite) is used as a "reserve devulcanizing agent" along with a second adsorption devulcanizing agent (Agent B) which may be any adsorption hydrodesulfurization (HDS) catalyst, such as Co-Mo/alumina and Ni/Mo/alumina (See paragraph 0010). This indicates that the reserve vulcanizing agent (Agent A) of Takashi process removes benzothiophene and dibenzo

thiophenes and the adsorption HDS catalyst (Agent B) removes other sulfur-containing compounds.

Regarding item 4 above, Satokawa discloses using desulfurizing agent (Agent A) comprising transition metals supported on a zeolite that functions at or in the vicinity of normal temperatures without resorting to the additional application of heat, thus making a device structure and operations simple (See paragraph 0031). Satokawa also discloses that sulfur compounds including not only DMS, but also sulfides, mercaptans, thiophenes and the like can be effectively, simultaneously removed from fuel gases containing such sulfur compounds (See paragraph 0032). Thus, Takashi's Agent A, substituted by Agent A of Satokawa is expected to remove other sulfur-containing compounds also along with thiophenes (encompassing benzothiophene and dibenzo thiophenes) at normal temperature. An express suggestion to substitute one equivalent component or process for another is not necessary to render such substitution obvious. *In re Fout*, 675 F.2d 297, 213 USPQ 532 (CCPA 1982).

Regarding item 5 above, the Table shows that use of either agent A or agent B is not as effective as the combination of agents A and B. Takashi clearly recognizes this synergistic effect of using both agents together. Thus, the modified Takashi invention (Takashi's agent A replaced by Satokawa's agent A) has identical combination of agents A and B as claimed and therefore, modified Takashi is expected to achieve similar performance on the removal of carbonyl sulfide (COS) and dimethyl disulfide (DMDS) as achieved by the Appellant.

The Appellant takes the position (page 6) that:

The Office continues to fail to recognize the mode of operation of the Takashi agent which is described in [0007] as follows (machine translation): This bromine reacts with sulfur and changes to a sulfur bromide with the adsorption capacity force higher than benzothiophene and dibenzothiophene. In contrast, the agent described by Satokawa is a simple adsorbent which does not provide for formation of a sulfur bromide and therefore, replacement of the Takashi Group 17 carrying zeolite with the agent of Satokawa would change the principle of operation of the primary reference and as described by Takashi is ineffective for the removal of benzothiophene and dibenzothiophene from a petroleum hydrocarbon.

In response, it is the examiner's position that the mechanism of reaction of bromine with the sulfur compounds does not negate the Takashi's agent (HBr supported on zeolite) to be substituted by a functionally similar Satokawa's agent (transition metals supported on zeolite), because both agents are desulfurizing agents intended for the same purpose. Additionally, one with ordinary skill in the art would use the latter because it can be used without any additional heating and is effective for removing different types of sulfur compounds in addition to thiophenes (encompassing benzothiophene and dibenzothiophene).

Takashi discloses, "This bromine reacts with sulfur and changes to sulfur bromide with the adsorption capacity force higher than benzothiophenes and

dibenzothiophenes" (Paragraph 0007). Takashi also discloses direct adsorption of sulfur compounds onto the adsorption desulfurization catalyst (See paragraph 0010).

Satokawa also discloses, "For the removal of a sulfur compound from a fuel gas, it is usual to use a hydrodesulfurization process or a process using an adsorbent. The hydrodesulfurization process comprises adding hydrogen to a fuel gas, decomposing and converting a sulfur compound into hydrogen sulfide in the presence of a catalyst such as a Co-Mo catalyst, and On the other hand, the process using an adsorbent is one wherein a fuel gas is passed through an adsorbent mainly composed of activated carbon, a metal oxide, zeolite or the like to remove a sulfur compound by adsorption. Although the process using an adsorbent includes a process wherein adsorptivity is increased by application of heat, adsorption at normal temperatures is preferred because a simpler system is realized" (Paragraph 0007, 0008). Thus, Takashi and Satokawa both teach removal of sulfur either by reaction followed by adsorption, adsorption alone, or reaction alone.

The Appellant takes the position (page 7-8) that:

Claimed Agent A has higher desulfurizing performance to sulfides and disulfides than that of Agent B, and Agent B has higher desulfurizing performance to carbonyl sulfide than that of Agent A. Both Takashi and Satokawa are silent with respect to removal of carbonyl sulfide. Appellants submit that the Office has basically alleged that since the combination of the references describes the same agents as the invention, the relationship according to Claim 2 would be satisfied.

However, as Appellants have shown the two references cannot be properly combined to obtain the claimed invention.

In response, it is the examiner's position that the modified Takashi invention (Takashi's agent A replaced by Satokawa's agent A) has identical combination of agents A and B as claimed and therefore, modified Takashi is expected to achieve similar performance on the removal of sulfides, disulfides and carbonyl sulfide as achieved by the Appellant.

In summary, Takashi discloses using "a petroleum system hydrocarbon" including LPG (See paragraph 0008). Satokawa discloses using fuel gases including LPG (See paragraph 0004, 0027; claim 10). Thiophenes disclosed by Satokawa (See paragraph 0032) is generic to benzothiophenes and dibenzothiophenes disclosed by Takashi (See paragraph 0005). Agent A disclosed by Takashi (HBr on zeolite) removes only benzothiophenes and dibenzothiophenes (See paragraph 0005) and Agent B (transition metals on inorganic oxides) removes remaining sulfur-containing compounds (See paragraph 0005, 0010). Agent A disclosed by Satokawa (transition metals on zeolite) removes other sulfur-containing compounds along with thiophenes at normal temperatures (See paragraph 0032; claim 4). Thus, agent A of Takashi substituted by agent A of Satokawa is expected to remove thiophenes along with other sulfur-containing compounds and modified Takashi process will have agent A and B as claimed and will necessarily achieve the synergistic effect as argued.

In conclusion, the claimed invention is *prima facie* obvious over Takashi in view of Satokawa.

(11) Related Proceeding(s) Appendix

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

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